TABLE 2-continued

Sensitivity gain using jet disturber equipped ion funnel for high concentration samples.

	M/z	Enhancement[a] Seven capillary[b]
100 pg/ul	193*	5.3
Taurocholic	514	5.9
500 pg/ul	80*	7.8
Reserpine	609	6.8
100 pg/ul	195*	6.6

[0025] a: compared to the spectrum with Sciex API 3000 standard interface, 0.25 mm orifice.

[0026] b: Seven 0.43X75 mm capillary, mechanical pump (D65B, 22 L/sec), ion funnel chamber pressure: 2.5 Torr, Q0 chamber pressure: 4.1 mTorr

[0027] *a major peak of MS/MS

[0028] It should be noted that while the present design with a single 0.51 mm I.D. 76 mm long capillary-ion funnel interface could transmit ion currents similar to that of the standard API 3000 orifice-skimmer interface, the heated capillary-ion funnel interface provided a greater ion current to IQ1. The standard orifice-skimmer interface has no significant differences in transmission for these low mass ions that have unstable trajectories in the RF-only quadrupole (Q0). Therefore, the present single capillary inlet-ion funnel interface provided about two times higher transmission efficiency than the standard interface for analyte related ions which can be attributed to the improved droplet desolvation and ion collection of the heated capillary-ion funnel configuration. The inlet transmitted current with seven 0.51 mm I.D. capillary inlet was more than seven times larger than that for a 0.51 mm I.D. capillary inlet. That higher transmission efficiency for the seven capillary inlet may be explained by the ion distribution, and the collective gas dynamic effects at the entrances of closely packed capillaries. The ion distribution at the entrance of the seven capillary inlet may vary due to space charge effects, and the gas flow at the entrance region of the multi-capillary inlet may be different significantly from the single inlet design. Table 2 also shows that a 0.51 mm I.D. seven capillary inlet provides a greater ion transmission efficiency than of a 0.43 mm I.D. seven capillary inlet, but that the transmission efficiency is not proportional to the conductance increase. The gas conductance of 0.51 mm I.D. capillary is about two times of that of 0.43 mm I.D. capillary, but the transmitted ion current for the 0.51 mm I.D. seven capillary was only 13% higher than that with 0.43 mm I.D. seven capillary inlet. The lower ion transmission gain with the 0.51 mm I.D. seven capillary inlet compared to the increased gas conductance may also be attributed to gas dynamic effects. Most importantly, Table 2 also shows that an interface with a multiple capillary inlet and ion funnel has about 23 times higher current to high vacuum stage (after Q0) compared to the standard orifice-skimmer interface.

[0029] Ion Detection Efficiency

[0030] Ion detection efficiency was evaluated with a 0.51 mm I.D. seven capillary inlet by monitoring ion current after the analyzing quadrupole. The resolution of analyzing quadrupole was tuned to achieve unit mass resolution. **FIG. 3** gives the ion currents measured before and after the analyzing quadrupole with the analyzing quadrupole set at m/z=228.3. The ion transmission efficiency through IQ1 was about 90%. **FIG. 3** shows about 30% transmission through the analyzing quadrupole and that the analyzing quadrupole transmitted current is approximately proportional to the ion current measured before the analyzing quadrupole. The analyzing quadrupole transmitted current of second isotopic peak (m/z=229.3) was also measured as 17% of the major isotopic peak (m/z=228.3) current, as expected.

[0031] Table 3 gives the sensitivity gain for different capillary inlets compared to the standard API3000 interface with 10 times diluted samples as used for Table 2 w experiment to eliminate the possible detector saturation. In these experiments, the ion funnel was equipped with a jet disturber as described in co-pending U.S. patent application Ser. No. _____, filed _____, "Improved Ionization Source Utilizing a Jet Disturber in Combination with an Ion Funnel and Method of Operation", the entire contents of which are incorporated herein by this reference.

TABLE 3

Sensitivity gain using jet disturber equipped ion funnel for low concentration samples.

	M/z	Enhancement[a] Seven capillary[b]
5-FU	129.0	12.6
50 pg/ul	41.8*	14.0
Minoxidil	210	20.5
10 pg/ul	193*	12.8
Taurocholic	514	16.0
50 pg/ul	80*	14.1
Reserpine	609	15.8
10 pg/ul	195*	10.2

For the comments of a, b, and *, see table 2.

[0032] If one assumes 100% ionization efficiency (i.e. complete conversion of solution species to gas phase ions) the present results indicate that the overall detection efficiencies are about 3% for two different seven capillary inlets. When we consider the transmission efficiency of the analyzing quadrupole is about 30% at the selected resolution, the ion transmission efficiency of the multi-capillary inlet and ion funnel interface can be estimated to be about 10%. Since this estimate is based upon the assumption of 100% ionization efficiency and operation at a relatively large flow rate where this is unlikely, it is apparent that the overall efficiency of the interface is considerably better than 10%.

[0033] Mass spectrometric detection allows us to evaluate the composition of the transmitted ion current and the resolution of analyzing quadrupole. **FIG. 4** shows a spectrum for the 4.0 μM DDTMA solution obtained using a 0.51 mm I.D. seven capillary inlet with the ion funnel interface. In this experiment, the electrospray emitter was intentionally positioned at off axis to protect the MS detector from degradation by a high ion current. The spectrum that shows 1 u resolution is dominated by the isotopic peaks of DDTMA and otherwise shows only very minor peaks due to impurities. This confirms that the current to the analyzing quadrupole (measured on IQ1) was primarily constituted of by analyte-related ions.

[0034] To study the detection efficiency for lower ion currents, mass spectra using a much more dilute 4.0 nM